Abstract

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A Comparison of Two Different Approaches to Multi-Criteria Optimisation of Semiconductor Fabrication

The process of wafer fabrication is arguably the most technologically complex and capital intensive stage in semiconductor manufacturing. This large-scale discrete-event process is highly re-entrant, and involves hundreds of machines, restrictions, and processing steps. Therefore, production control of wafer fabrication facilities (fabs), specifically scheduling, is one of the most challenging problems that this industry faces. The reason of its high applicability in semiconductor manufacturing is due to the fact that in semiconductor manufacturing the machines used in the product line are extremely expensive and comprise 75% of the total cost of the fabrication facility. Consequently, each wafer revisits the same machines several times to produce different layers. This paper examines the optimisation solution for the operation of a small re-entrant semiconductor fab under two approaches. The first considers employing an evolutionary algorithm to the multi-objective optimisation by weighting each of the objectives in order to obtain a single objective function. This requires some a-priori external knowledge of the relative importance of the competing objectives and results in a single solution that may be considerably sensitive to the weights. By contrast, the second uses a pareto-optimal genetic algorithm to develop a true multi-objective solution to the same problem. Here no a-priori external knowledge is required and the decision maker is presented with a set of non-dominated solutions to assist in ion of the most appropriate solution to implement. Both solutions are developed using discrete event simulation models of the Five-Machine Six Step Mini-Fab built in ExtendSimTM.